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ABSTRACT

Two major factors in updating the skills of professional personnel--motivation and organizational climate--are integral parts of the concept of lifelong education for updating. A principal determinant of motivation is said to be achievement motivation; a professional must be highly motivated in order to maintain competence throughout his career. It is stated that achievement motivation can be developed in persons as well as built into jobs. Organizational climate is defined as organizational and management practices that arouse motivation, condition attitudes, and shape behavior on the part of its members. A high organizational climate is seen as emphasizing the following characteristics: achievement, concern for excellence, emphasis on problem solving, high reputation for work performance, appropriate training, supportive and friendly atmosphere, and initial job orientation. The relationship between supervisor and subordinate is seen as crucial in the professional development of the subordinate. Three types of supervisors are identified: the innovator, the administrator, and the inactive supervisor. On-the-job learning is considered an important variable of organizational climate, as is the stimulation provided by peer interactions as well as interaction with superiors and subordinates. It is believed that a company should have a written policy that requires updating for its employees. (DB)

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The Psychology of Keeping Up-To-Date

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When setting out to write about keeping up-to-date, one is vulnerable to the obvious criticism that he may himself be becoming obsolete, a victim of the process which besets all living organisms — growing old. The author wishes to disarm his critics at once by admitting no immunity to the inexorable process of aging. One needs only to be required to use glasses for reading fine print or to miss a few soft spoken words of a conversation to be forced to admit that his sensory processes are going into a decline. However, having made this admission and this disclaimer, we can proceed on hopefully to resist or modify the debilities brought on by the passage of time.

During the working years of a professional man or woman — roughly between the ages of 30 and 65 — a critical issue is whether or not a high level of competence and creative productivity can be maintained against the eroding effects of time. A highly trained person must constantly renew his knowledge. The goal is not merely to keep knowledge already acquired during the period of formal education. Much more than this — for past knowledge may become outdated — the aim is constantly to recharge the batteries which motivate and trigger self-renewal by keeping abreast of new knowledge that is constantly being added by research and publication.

The decline of competence in professional persons which often accompanies the passing of years is not inevitable or necessary except in the presence of ill health or other extreme debilitating factors. Obsolescence is a normal though decremental process that nevertheless responds favorably to

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updating efforts. What is needed for middle-aged persons is a new image of education — life-long education in which the learning process is continuous and unbroken. In familiar terms, this is continuing education but with a new and dynamic meaning. The range of educational activities for updating should cover a whole spectrum which essentially comprises a self-education program: reading, working on projects that stretch one's capacity to the limits, conversation, discussion and argumentation with colleagues, meetings, seminars, and courses in formal classes, studying by correspondence or television or by other media.

Professional updating is concerned with the imparting of needed new and different skills, as well as expanding on previously learned competencies so as to incorporate the latest developments in a professional field. Updating is of special concern to technology-based organizations where organizational success is highly dependent on effective utilization of the most advanced technologies. In our rapidly changing business environment, updating is increasingly recognized as important for managerial and technical personnel.

This paper will discuss the factors identified with updating. To provide a background for this discussion, the notion of the half life of the professional, the meaning of obsolescence, and symptoms and causes will be presented.

The Half Life of a Professional

A useful measure for estimating the extent of obsolescence in various professions is the concept of half-life, a term taken from nuclear physics. The half-life of a professional's competence can be described as the time

after completion of professional training when, because of new developments, practicing professionals have become roughly half as competent as they were upon graduation to meet the demands of their profession. Dr. Edward C. Rosenow, Jr. (1), Vice-President of the American College of Physicians, recently estimated the half-life of medical knowledge to be five years. Professor J. Lukasiewicz (2), of Carleton University in Ottawa, has stated that while the half-life of a 1940 engineering graduate was twelve years, it has shrunk to five years for today's graduate.

The factor which figures most prominently in hastening obsolescence is the rate of change in the discovery and application of new knowledge. Professional people, well-trained in their specialties, are finding their knowledge and methods out of date after only 5 to 10 years on the job. Not only does one have to keep abreast of his own area but what is going on in related fields.

In order to keep abreast of new publications, according to George and Dubin (3), 20% of a professional's working time should be devoted to updating. Chapanis (4) estimated that a compulsive, well-versed engineering psychologist would have to read 30 or 40 articles, books, theses, and technical reports every day of the year merely to keep abreast of the current literature. If the psychologist has difficulty in keeping up within his field, consider the lot of the biologist or the physical scientist in which new information is added to the field in vastly greater amounts. For instance, the number of entries in Biological Abstracts (5) rose from 40,000 in 1957 to about 110,000 in 1967, and Chemical Abstracts published about 244,000 in 1967.

What Does Obsolescence Mean?

At the present time, only descriptive and operational definitions of obsolescence have been advanced. Comparatively little experimental work

has been done. Most of the inquiry and literature to date has come from empirical investigations in engineering, medicine, and management. However, several investigators have focused on factors underlying obsolescence. Burack and Pati (6), Mahler (7), and Shumaker (8) have defined obsolescence in terms of a reduction of efficiency of performance over time. Burack and Pati found that obsolescence exists when there is a discrepancy between job needs and managerial or professional capabilities as a result of innovation; or when the knowledge and skills of a manager are not sufficient to accomplish his job. Mahler described managerial obsolescence as the failure of the once capable manager to achieve results that are currently expected of him. According to Shumaker, obsolescence is a reduction in technical effectiveness resulting from a lack of knowledge of the new techniques and of entirely new technologies that have developed since the acquisition of the individual's education.

In the field of engineering, Zelikoff (9), Mali (10), and Siefert (11) use the word obsolescence to mean the erosion of the applicability of knowledge. Zelikoff analyzed catalogue course offerings for five engineering colleges from 1935 to 1965 at five-year intervals. By identifying courses that were dropped and courses that were added, he developed engineering erosion curves for five areas of engineering. Figure 1 shows the potential obsolescence of knowledge in chemical engineering as measured by the number of course additions and deletions in the curriculum. The steeper curves in later years represent the rapid increases in technological advancement. For example, for the class of 1935, the percentage of applicable knowledge in 1965 is about 15%; for the class of 1960, it is about 45% in 1965.

Another approach to the definition of obsolescence has been advanced by Mali in the form of an obsolescence index (OI):

$$OI = \frac{\text{current knowledge understood by engineers}}{\text{current knowledge in the field}}$$

This equation is based on the rate of change versus time. A high rate of technological obsolescence is related to a high rate of growth. The growth curve expresses the exponential rate of technological obsolescence. Siefert defined obsolescence for engineers as the measurement at some point of time of the difference between the knowledge and skills possessed by a new graduate of a modern engineering curriculum and the knowledge and skills actually posssessed by the practicing engineer who may have completed his formal education a number of years ago.

Ferdinand (12), Norgren (13), and Mahler (7) found several types of obsolescence for the purpose of identifying the nature and causes of obsolescence among engineers and scientists. Ferdinand described three types: professional, areal, and ex-officio. In his opinion, remedial programs could be more effectively implemented once the type of obsolescence was determined. Norgren classified the major types of skill obsolescence as technology-based and product-based. Mahler had numerous categories of obsolescence, the most important of which were those of ability and attitude.

It is apparent from the foregoing review of attempts to describe obsolescence that a behavioral definition is still to be developed. There is a critical need here for experimental work.

Symptoms and Causes of Obsolescence

The causes of professional obsolescence are many, and a number of interacting factors appear to be involved. Several authors have pointed out that certain attitudes, behaviors and motivational patterns are symptomatic of obsolescence and hence provide guidelines for detecting it.

Malmros (14) described five signs of obsolescence in the engineer: 1) he became less and less inclined to apply rigorous mathematical techniques to obtain solutions to his problems; 2) he encountered increasing difficulty in reading new technical papers and felt frustrated because he could not follow the mathematics; 3) new technical concepts were confusing to him; 4) new tasks and assignments began to look too difficult to be practical; and 5) contemporaries did not seek his advice. Burack and Pati (6) pointed out to managers some danger signals which should alert them of creeping obsolescence in themselves. They identified a number of conditions conducive to managerial obsolescence: lack of awareness of change; lack of aptitude to learn; out-dated education; lack of motivation for self-education because of age and low level of aspiration; heavy family obligations; desire to maintain status quo; lack of broader education for the development of conceptual skills; and failure to perceive potential future change.

Some professionals are made obsolete by the organizations in which they work. They are kept obsolete by the limited demands and rigid controls which prevent them from enlarging their scope. A man may be required to overspecialize to the point where he operates on a low level of use of his professional knowledge. Or it may be the individual himself who chooses a specialization which is so narrow he becomes unaware of new developments in the rest of his profession. Further, the mutual expectancies between the individual and the organization can create or combat obsolescence. This is what Levinson (15) calls the psychological contract. "What the person expects from the organization, his experiences in dealing with the organization, and how much he trusts the organization for need fulfillment influences his updating."

FACTORS IN UPDATING

Clearly, the process of updating requires radical changes in educational and professional thinking, not the least of which is the recognition that lifelong education for updating must become an integrated part of professional practice. The traditional concept of education which is essentially terminal education — that is, the completion of a formal program in a prescribed number of years as adequate preparation for a lifetime of work — must give way to a concept of lifelong education as a requisite ingredient in a professional career. The half-life of the practicing professional can rarely be extended by a casual attempt on the part of the individual to keep up with new developments; the constant process of rejuvenation requires a systematic approach.

Motivation for Professional Updating

One of the toughest problems in combatting professional obsolescence is motivation; a professional person must be highly motivated in order to maintain competence throughout his career. An effort in this direction has been made by Dubin (16) and Dubin and Cohen (17). Their model described the motivation to update as a multi-dimensional process comprising psychological and environmental variables such as achievement motivation, organizational climate that nurtures creativity, supervisory behavior that encourages professional growth, challenging work projects that promote on-the-job problem solving, peer and group interaction that allow for interchange and seeking of information, and a management policy that rewards updating.

A principal determinant of motivation is achievement motivation. By definition, achievement refers to competition with a standard of excellence. Persons who are highly motivated are generally attracted to activities which require skill and excellence in performance.

McClelland and Winters (18) summarized the behavioral characteristics of achievement-oriented managers. They found that high levels of achievement motivation are associated with entreprenurial behavior, innovative risk-taking, and business success. The following are characreristics of a person who shows a high degree of need achievement: 1) seek and assume a high degree of personal responsibility; 2) take moderate or calculated risks; 3) set challenging but realistic goals for himself; 4) develop comprehensive plans to help attain his goals; 5) show preference for problem situations which provide feedback of his performance; 6) seek out business opportunities where his desire to achieve will not be thwarted; 7) spend time thinking about how to get things done better and take pride in accomplishment; 8) show more initiative and exploratory behavior by continually researching the environment to find tasks he can solve to his satisfaction.

Achievement motivation can be developed in persons as well as built into jobs. It is one way of maximizing the unused potential of subordinates.

Professor Lyman Porter (19), a psychologist at the University of California, recently gave a paper at a symposium, Motivation for Professional Updating. At this meeting Porter advanced a theoretical approach for understanding motivation in professional updating by the use of expectancy theory. How the professional evaluates different kinds of potential rewards is significant. Rewards can be intrinsic, a feeling of accomplishment, self-fulfillment, or extrinsic, a pay increase, promotion, favorable evaluation, etc. An organization can influence the employee's expectations by its actions of rewarding for keeping abreast of current knowledge. The employee's expectations are influenced by his observations on whether those who keep up are rewarded or not rewarded. This involves a matter of trust — will the organization reward him for pursuing professional updating?

An excellent report on the motivation of R & D scientists in maintaining their scientific competence along with the views of top management on continuing education was recently published by Renck, Kahn and Gardner (20). In another study, Margulies and Raia (21) interviewed scientists and engineers in advanced R & D technology laboratories and found that the two activities which best motivated their professional growth were on-the-job problem solving (42%), and the interaction with colleagues (20%). Dill (22) emphasized the importance of personal initiative in coping with obsolescence.

Organizational Climate

The major environmental factor in updating is organizational climate. A number of topics will be discussed which reflect high organizational climate, namely: supervisory relationships, on-the-job problem solving, colleague interaction, and company policy.

Organizational climate can be defined as organizational and management practices that arouse motivation, condition attitudes and shape behavior on the part of its members (23). A high organizational climate (24) emphasizes the following characteristics: achievement - a desire on the part of people in the organization to do a good job and contribute to the performance of the company; concern for excellence - degree to which the group is concerned with improving individual performance, being flexible, innovative and competent; emphasis on problem solving - extent to which group anticipates and solves problems related to group functioning; high reputation for work performance - reflects status and reputation of individual's work group as compared to other work groups; provides appropriate training for individuals - degree to which organization provides appropriate training for individuals; provides supportive and friendly atmosphere - degree to which supervisors generate a supportive and friendly atmosphere; initial job orientation - individuals are informed on what to expect when they first start on the job.

Supervisory Behavior

The relationship between supervisor and subordinate is a crucial one. Our studies on engineers and managers indicate that supervisors are not developing their subordinates' professional growth. In a recent study (25) we completed, 64% of 2000 engineers reported that their supervisors took a noncommittal attitude towards their education and development. Similarly (26) in other studies, 51% of 3600 industrial managers and 42% of natural resource managers reported that their superiors are noncommittal about their further training. These findings suggest that supervisors are not developing their subordinates' potential to the maximum. Corroboration of these findings was reported in a recent 1969 National Science Foundation Study (20) on R & D scientists and engineers: about one-third of the scientists and just under one-half of the engineers report attitudes of non-interest on the part of their supervisors on their professional development.

Landis (27) in an industrial study of engineers, asked this question: "How does your immediate supervisor feel about further job-directed education or training?" Fifteen percent reported "very encouraging"; 47%, "somewhat encouraging"; and 37%, "not encouraging at all." He concluded that it is "the immediate supervisor that counts in the development of subordinates. If a boss does not encourage a man, he will not take further course work . . . unless the supervisor is willing to encourage and accomodate his men in spite of the possible interference with his work schedule, few men will undertake continuing studies."

The National Science Foundation Study (20) provided further evidence of the key position of the supervisor. Three types of supervisors were identified: the innovator, the administrator, and the inactive supervisor. The innovative supervisor "tries to create new opportunities in addition to existing ones, to provide novel and interesting ways for subordinates to

undertake continuing education. The inactive supervisor is passive and noncommittal in his attitudes. He conceives self-development as a responsibility of the employee apart from the working environment. He neither stimulates subordinates to pursue additional knowledge nor initiates continuing education on their behalf. The administrator conceives of his job as implementing organization policies and encouraging subordinates to use existing resources for self-development. The type of supervisor classified as administrator, innovator, or inactive determines the motivational level of subordinates.

On-the-Job Problem Solving

Another important variable or organizational climate is on-the-job learning. Margulies and Raia (21) asked 290 R & D scientists and engineers: "What was the most fruitful learning experience you have had over the past year or two?" The most frequent response was on-the-job problem solving (42%). This was described as being assigned to "interesting tasks," "broadening projects," and "writing proposals which force me to dip into the literature and become current on everything connected with the project." When on-the-job activities include challenging assignments, the exploration of new tasks enables the scientist and engineer to assess his own knowledge and fill in his gaps and deficiencies.

In the engineering context, on-the-job problem solving provides meaningful learning experiences. Activities such as designing new equipment, being assigned new tasks, or completing a project are work activities that can be exciting, interesting, and challenging. They provide the success experiences which play an important role in motivating the individuals to keep up-to-date and grow continuously. Responsibility, job involvement, and challenging work assignments all contribute to the first steps to continuing education — awareness of needs and individual motivation.

Colleague Interactions

An important part of the organizational environment is the stimulation provided by peer interactions among scientists and engineers. Colleague interactions are a major source of job related learning because they promote learning, innovation, and the development of ideas. These experiences come from interchange with others, working with manager and experts, talking to people or participating on panels and committees.

Rosenbloom (28) conducted an interesting study on the flow of technical information into engineering and scientific groups in industrial laboratories. He was studying technology transfer, or how new knowledge, new understanding, which originates in one place, gets communicated and used in another place. He found that most information that engineers in industrial laboratories acquire comes to them by word of mouth from local sources.

Rosenbloom described two types of professionals working in laboratories, each with marked differences in personal characteristics and sources of information they use. The people who use sources outside the laboratories tend to be a fairly well defined group who publish papers, who go to meetings, who have higher education, who tend to be working on the more basic problems. They belong to professional organizations and report a lot of oral communications with other professionals employed in organizations outside their own.

The other group go to meetings less frequently, rarely publish and get their information by talking to other people in the laboratory. A person in this group talks to the boss, the man in the next department, to marketing people, and production people. He keeps up to date by talking to people in other divisions in his company and by reading trade magazines. The existence of an organizational climate that encourages interation among colleagues, superiors and subordinates, cannot be overstated. Much learning occurs through informal discussion and consultations.

Management Philosophy

Finally, a company should have a written policy that requires updating for its employees. Many companies have educational assistance funds which reimburse employees who undertake continuing education courses, but few companies make continuous updating mandatory. In our study of engineers, 79% reported that their companies had educational assistance programs, showing the widespread availability of company payment for educational courses, but three-fourths of the engineers reported that this availability had no effect in motivating them to undertake additional work. Similarly, half of middle managers (26) said that company policy on financial aid had little effect on their decision to undertake further education. Evidence derived from these studies also indicated that taking additional course work was not sufficiently rewarded in industry and was not a requirement for promotion or salary increases. The availability of financial assistance for self improvement is obviously not a sufficient incentive for updating in employees.

In summary, I have discussed two major factors of updating: motivation and organizational climate. Motivation is a key variable but the process is multidimensional. It involves organizational climate, supervisory behavior, on-the-job learning, peer interaction, and a policy which requires keeping abreast a consistent activity.

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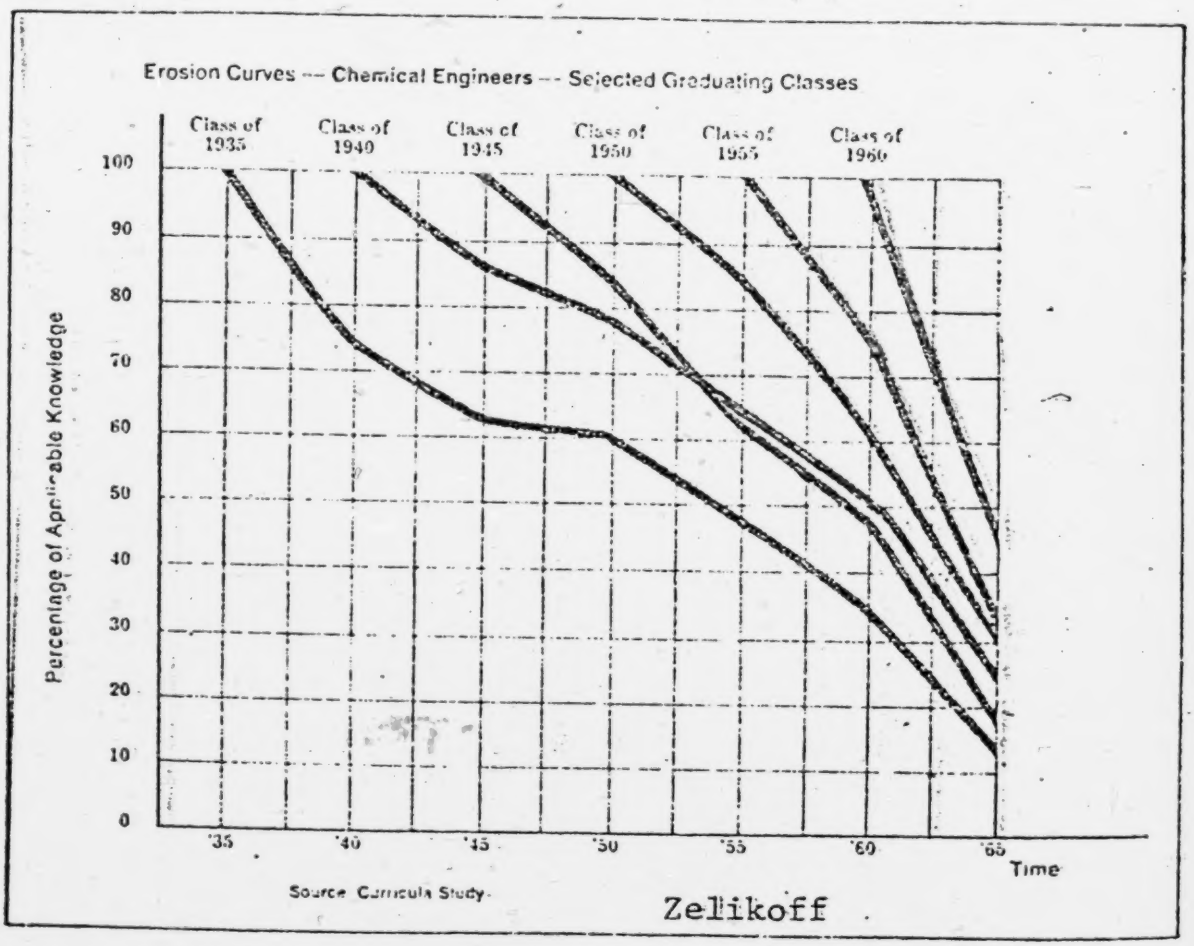
FIGURE 1. CHART SHOWING AMOUNT OF POTENTIAL OBSOLESCENCE AS MEASURED BY THE NUMBER OF COURSE ADDITIONS AND DELETIONS IN ENGINEERING CURRICULA.



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